CS123-45
Diamond-Powder

U. S. DEPARTMENT OF COMMERCE
HENRY A. WALLACE, Secretary

NATIONAL BUREAU OF STANDARDS
LYMAN J. BRIGGS, Director

GRADING OF DIAMOND POWDER

COMMERCIAL STANDARD CS123-45

Effective Date for New Production, From May 5, 1945

A RECORDED VOLUNTARY STANDARD OF THE TRADE

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PROMULGATION

of

COMMERCIAL STANDARD CS123-45

for

GRADING OF DIAMOND POWDER

On June 27, 1944, at the instance of the Miscellaneous Minerals Division of the War Production Board, a meeting of producers of diamond powder adopted a proposed commercial standard for grading of diamond powder. This was submitted on July 11, 1944, to leading users of the product and interested Government agencies for constructive comment. Following adjustment of the proposal in agreement with comment, the recommended commercial standard was circulated for written acceptance on September 19, 1944, and on March 6, 1945, it was announced that those concerned had accepted and approved the standard as shown herein for promulgation by the United States Department of Commerce, through the National Bureau of Standards.

The standard is effective for new production from May 5, 1945.

Promulgation recommended.

I. J. Fairchild,
Chief, Division of Trade Standards.

Promulgated.

Lyman J. Briggs,
Director, National Bureau of Standards.

Promulgation approved.

Henry A. Wallace,
Secretary of Commerce.

GRADING OF DIAMOND POWDER

COMMERCIAL STANDARD CS123-45

PURPOSE

1. The purpose of this commercial standard is to provide a nationally recognized standard for grading diamond powder, to provide a basis for understanding between purchasers and sellers as to the quality and grade desired or supplied; and to provide a uniform method of guaranteeing conformance with the grade designated.

SCOPE

2. This standard covers material, grade designations, grain size and size range, amount of "fines", or particles, smaller than the minimum for each designation, impurities, methods of sampling and inspection, and method of guaranteeing compliance with this standard.

DEFINITIONS

3. *Grade designations.*—The grade designations employed in this standard are the arithmetical means, or whole numbers near the arithmetical means of the designated maximum and minimum grain sizes for the grades, expressed in microns.

4. *Grain size.*—For the purpose of this standard the size of the grain is one-half the sum of its longest dimension and the maximum dimension at right angles to its longest dimension, both measurements taken on the face exposed to view in the microscopic field and expressed in microns.

5. *Fines.*—For the purpose of this standard a "fine" is any particle smaller than the minimum for any specified grade.

GENERAL REQUIREMENTS

6. *Material.*—Diamond powder shall consist of crushed diamond or bort. It shall be graded for size as specified in table 1.

DETAIL REQUIREMENTS

7. *Grade designations.*—Grade designations and size ranges are given in table 1. It is not intended that all manufacturers shall supply all grades listed in table 1. In case intermediate grades are supplied, the minimum and maximum sizes for any such grade shall be determined by interpolation between the minima and maxima of the adjacent higher and lower grades.

8. *Large particles and fines.*—No particles larger than the maximum size specified for the grade under grain size in table 1 shall be present. Fines shall not be present in an amount numerically greater than 10 percent of the total number of particles in grade 40 and coarser, and not greater than 50 percent in grade 25 and smaller. Particles under 0.5 micron in size, which are not easily visible with the microscope, are to be disregarded. Fines shall not constitute more than 3 percent of the total weight.

TABLE 1.—*Grades.*

Grade designation [1]	Grain size (microns)		Sieve number (through) [2]
	Minimum	Maximum	
1	0	2	---
2	1	3	---
3	1	5	---
3X	0	6	---
6	4	8	---
8	6	10	---
8X	4	12	---
14	8	20	---
25	13	37	---
40	20	60	325
60	35	85	230
90	60	120	170
120	80	160	120
150	100	200	100
180	120	240	80
250	150	350	60
400	250	550	40

[1] Grades 1, 6, and 8 are narrow-range grades for exacting work in cutting and polishing fine diamond dies, sapphire bearings, etc. Grades 3X and 8X are wide-range grades desired for some purposes.

[2] United States Standard Sieve series. Sieve numbers are included for reference only. It does not necessarily follow that powders passing the sieve indicated for a grade will meet the grain-size requirements of that grade, nor that powders retained on the sieve necessarily fail to meet the grain-size requirements.

9. *Impurities.*—Grade 40 and coarser shall contain less than 2 percent by weight of impurities; a maximum of 5 percent total impurities is permitted in grades finer than grade 40.

METHODS OF SAMPLING AND INSPECTION

10. *Sampling.*—Lots of 100 carats or less shall be quartered[1] to obtain a sample of the desired size. Lots larger than 100 carats may be thoroughly mixed and a representative sample of about 100 carats taken and quartered.

11. *Identification.*—Diamond powder can be identified, and the presence of impurities can be detected by a competent laboratory familiar with petrographic methods of microscopic examination.

12. *Grain size.*—A sample weighing 0.1 carat or less, obtained by quartering as described in paragraph 10, shall be placed on a glass slide and moistened with a drop of pine oil or other adequate dispersant, then thoroughly mixed and covered with a cover glass. Excess oil is pressed out and removed by blotting with absorbent paper. The slide is then placed under a microscope having a suitable ocular and objective. The sizes of the particles are determined as specified in paragraph 4 by measuring with a micrometer eyepiece or by means of dividers on a photomicrograph of known enlargement.

12a. The entire slide shall be examined systematically for particles larger than the maximum for the grade designated. If any particle is found that exceeds the maximum specified for the grade, the powder fails to meet the requirements of this standard. If the powder is not rejected for that reason, not less than four randomly selected fields

[1] *Sampling by quartering.*—The quantity of powdered material to be quartered is thoroughly mixed and formed into a symmetrical heap on a sheet of glazed paper by alternately raising and lowering opposite edges of the paper. By the use of a spatula, the heap of material is then divided approximately into quarters by two straight lines intersecting at right angles at the center of the heap. Two opposite quarters are removed and the two remaining quarters are mixed and divided as before, repeating the cycle until a sample of the desired size remains.

containing a total of not less than 400 particles shall be examined. Several particles near the minimum size specified for the grade shall be measured as specified in paragraph 4 and used for reference in counting fines. The total number of particles and the number of fines are recorded. If the number and size of the fines indicate a possibility that the weight of fines represents as much as 3 percent of the total weight, the percentage by weight shall be determined by the procedure given in paragraph 13.

13. *Weight of fines.*—The weight of fines in sizes coarser than 60 shall be determined by sieving. If the microscopic examination of grades 60 or finer indicates that fines may be present in an amount greater than 3 percent by weight, the percentage is determined by the following procedure:

13a. A 5 g (25 carats) quartered sample of the diamond powder is weighed accurately on an analytical balance. The sample is then mixed with 100 ml of a 0.1–percent-gelatin (U. S. P.) solution (in distilled water), the pH of which has been adjusted with sodium carbonate to 9 ±1. This slurry is stirred and shaken for at least 1 hour. It is then made up to exactly 250 ml with 0.1–percent-gelatin solution in a 250–ml cylindrical graduate and again shaken and stirred.

13b. The cylinder is set at rest and kept at a temperature of 25° ±1°C for the length of time indicated in table 2, the time of sedimentation beginning when the cylinder is set at rest. At the end of the sedimentation time, a 5–ml portion is withdrawn from a point exactly 5 cm below the surface of the liquid with a pipette calibrated to contain 5 ml. A mark should be made on the pipette to facilitate 5–cm immersion of the tip. The pipette remains stationary and is not lowered to follow changes in level of liquid in the graduate.

13c. The withdrawn portion is discharged into a tared beaker or weighing bottle. The pipette is rinsed with warm distilled water and the rinsings added to the beaker. Evaporate the water and dry in an oven at a temperature not above 110°C. Cool in a desiccator and weigh.

13d. Subtract the weight of the dried gelatin (0.0050 g) from the total weight of the dry residue from method 13c to obtain the net weight of fines in the withdrawn portion. Multiply this weight by 50 to obtain the weight of fines in the original sample and compute percent by weight, or use the formula.

$$\text{Percentage fines by weight} = \frac{250}{5} \times \frac{\text{Net weight of fines in withdrawn portion}}{\text{Weight of sample}} \times 100.$$

TABLE 2.—*Sedimentation time*

Grade designation	Minimum grain size (microns)	Sedimentation time at 25°C		
		Hours	Minutes	Seconds
2 or 3	1	9	15	30
6 or 8X	4	--	34	45
8	6	--	15	10
14	8	--	8	25
25	13	--	3	20
40	25	--	--	54
60	35	--	--	27

14. *Impurities.*—If the microscopic inspection shows the presence of impurities in amounts greater than minute traces, the amount shall be determined by digesting with acid an accurately weighed sample of approximately 5 carats (obtained by quartering a representative sample as described in paragraph 10). (See notes 1, 2, and 3 on page 5.) Normally only total impurities are determined (see note 5).

14a(1). If oil or other organic matter is present, the 5–carat sample shall be digested with 5 to 10 ml of hot bichromate cleaning solution (see note 4). After the digestion is judged complete, the diamond powder shall be settled by centrifuging, and the cleaning solution decanted without mechanical loss of diamond powder. The powder is then washed with not less than five 10–ml portions of distilled water, centrifuged, and decanted between washings. The final decanted portion of water should be colorless. The powder is then dried to constant weight in an oven at approximately 105° C. The percentage loss in weight is computed.

14a(2). After weighing, the washed powder is quartered to obtain a 0.1 carat or smaller sample for microscopic examination. This sample shall be examined microscopically to detect the presence of impurities not removed by the acid treatment. Complete removal of organic material shall be shown. If other types of impurities are also absent, digestion with other acids is unnecessary. If other impurities are present, the residue from taking the 0.1-carat sample for the microscopic examination is accurately weighed and other impurities determined by methods 14b and 14c, or a new 5-carat sample may be taken and digested with bichromate cleaning solution, settled, decanted, and washed for use in methods 14b and 14c. (See note 5.)

14b. If metal particles or metal salts are present (in the absence of organic material), a sample of the diamond powder shall be digested at room temperature with 5 to 10 ml of 10-percent hydrochloric acid, settled, decanted, and washed, followed by digestion with 5 to 10 ml of 10-percent nitric acid, after which it is again settled, washed at least three times, dried, and the loss in weight determined as above. A microscopic examination of a 0.1 carat or smaller quartered sample of the washed powder shall show complete removal of the metal and metal salts. The percentage of metallic impurities shall be computed on the powder in its original condition.

14c(1). If the microscopic examination shows the presence of siliceous material, such as glass or sand, washed powder from method 14b may be used for analysis if not less than 4 carats remain; or a new 5-carat sample may be taken and treated as in methods 14a and 14b to remove organic and metallic impurities.

14c(2). Transfer the accurately weighed sample of not less than 4 carats to a suitably sized clean platinum dish or crucible, weighed with cover. Moisten the sample with few milliliters of water, add 10 to 15 drops of diluted sulfuric acid (1+1) and 10 ml of hydrofluoric acid (40%). Evaporate on a sand bath or hot plate to fumes of sulfuric acid. Care should be taken to avoid loss by spattering. Cool the dish, add a few drops of water, 5 ml of hydrofluoric acid (40%), and repeat the evaporation to fumes. Continue the heating until all sulfuric acid and sulfates have been expelled. Cover the dish, transfer to a desiccator, cool, and weigh. The loss in weight is recorded as silica (SiO_2) and the percentage computed on the original weight of powder.

14d. The sum of the percentage loss in weight in methods 14a, 14b, and 14c is reported as "percentage of total impurity."

NOTE 1.—Experienced microscopists can often estimate with some accuracy by inspection alone, the percentage of impurities. Except when inspecting for referee cases or court evidence, the microscopist may omit the chemical determinations if he is certain by inspection that the percentage is below the specified maximum.

NOTE 2.—The presence of large amounts of foreign material usually interferes seriously with close grading. For that reason, powders containing high percentages of foreign material will often be rejected because they do not fall within the size ranges shown in table 1. If the powder is rejected for that reason, it may be considered unnecessary to make a quantitative determination of the impurities present. In such cases, unless the laboratory is specifically instructed to make the determination, a report may state the cause for rejection and merely indicate that high percentages of impurities were shown by the microscopic examination.

NOTE 3.—In the absence of graphite, organic material, carbonates, and carbides, or after their removal, laboratories equipped for and skilled in the determination of carbon by combustion may determine the diamond content as carbon and compute impurities by difference. As relatively small samples are used for carbon determination, great care must be taken in quartering and weighing the sample.

NOTE 4.—The bichromate cleaning solution is made by adding one liter of reagent grade concentrated sulfuric acid to 35–ml saturated solution of potassium bichromate chemically pure in distilled water. Add the acid to the bichromate solution slowly, stirring constantly with a glass rod.

NOTE 5.—When more than one type of impurity is observed the necessary digestions and washing may be conducted on the same sample without intermediate drying and weighing, total impurities being reported. In all cases when organic matter is present, treatment with bichromate cleaning solution should precede treatment with other acids. Whenever microscopic examination shows incomplete removal of any impurity, the determination shall be repeated on a new sample by using a larger amount of acid or longer digestion time, as appears necessary.

GUARANTEE

15. It is recommended that manufacturers guarantee compliance with this standard by means of the following statement on labels, invoices, sales literature, etc:

> The manufacturer guarantees this diamond powder to conform with all requirements of Commercial Standard CS123–45, as issued by the National Bureau of Standards of the United States Department of Commerce.
>
> Grade_____.

EFFECTIVE DATE

16. The standard is effective for new production from May 5, 1945.

STANDING COMMITTEE

17. The following individuals comprise the membership of the standing committee, which is to review, prior to circulation for acceptance, revisions proposed to keep the standard abreast of progress. Comment concerning the standard and suggestions for revision may be addressed to any member of the committee or to the Division of Trade Standards, National Bureau of Standards, which acts as secretary for the committee.

Herbert Insley, (chairman), The Pennsylvania State College, State College, Pa.
Bert Brenner, Diamond Development Company of America, Inc., 1650 Broadway, New York, N. Y.
G. P. Brockway, American Optical Co., Southbridge, Mass.
F. E. Koebel, J. K. Smit & Sons, Inc., 157 Chambers St., New York 7, N. Y.
A. A. Klein, Norton Co., Worcester, Mass.
Nathan Salzman, General Diamond Co., 576 Fifth Avenue, New York 19, N. Y.
C. B. Shopmyer, General Electric Co., Schenectady 5, N. Y.
E. W. Weimar, Jr., U. S. Industrial Diamond Corporation, 420 Lexington Ave., New York 17, N. Y.
Horace Winchell, Hamilton Watch Co., Lancaster, Pa.
Fine Wire Manufacturers Association, 1427 Eye Street, Washington, D. C.
(Represented by B. L. McCarthy, Wickwire Spencer Steel Co., 500 Fifth Avenue, New York 18, N. Y.)

ACCEPTANCE OF COMMERCIAL STANDARD

If acceptance has not previously been filed, this sheet properly filled in, signed, and returned will provide for the recording of your organization as an acceptor of this commercial standard.

Date _____

Division of Trade Standards,
National Bureau of Standards,
Washington 25, D. C.

Gentlemen:

We believe that the Commercial Standard CS123–45 constitutes a useful standard of practice, and we individually plan to utilize it as far as practicable in the

Production [1] Distribution [1] Use [1] Testing [1]

of diamond powder.

We reserve the right to depart from it as we deem advisable.

We understand, of course, that only those articles which actually comply with the standard in all respects can be identified or labeled as conforming thereto.

Signature of authorized officer _____
(In ink)

(Kindly typewrite or print the following lines)

Name and title of above officer _____

Organization _____
(Fill in exactly as it should be listed)

Street address _____

City, zone, and State _____

[1] Underscore which one. Please see that separate acceptances are filed for all subsidiary companies and affiliates which should be listed separately as acceptors. In the case of related interests, trade papers, etc., desiring to record their general support, the words "general support" should be added after the signature.

(Cut on this line)

TO THE ACCEPTOR

The following statements answer the usual questions arising in connection with the acceptance and its significance:

1. *Enforcement.*—Commercial standards are commodity specifications voluntarily established by mutual consent of those concerned. They present a common basis of understanding between the producer, distributor, and consumer and should not be confused with any plan of governmental regulation or control. The United States Department of Commerce has no regulatory power in the enforcement of their provisions, but since they represent the will of the interested groups as a whole, their provisions through usage soon become established as trade customs, and are made effective through incorporation into sales contracts by means of labels, invoices and the like.

2. *The acceptor's responsibility.*—The purpose of commercial standards is to establish for specific commodities, nationally recognized grades or consumer criteria and the benefits therefrom will be measurable in direct proportion to their general recognition and actual use. Instances will occur when it may be necessary to deviate from the standard and the signing of an acceptance does not preclude such departures; however, such signature indicates an intention to follow the commercial standard where practicable, in the production, distribution, or consumption of the article in question.

3. *The Department's responsibility.*—The major function performed by the Department of Commerce in the voluntary establishment of commercial standards on a Nation-wide basis is fourfold: first, to act as an unbiased coordinator to bring all interested parties together for the mutually satisfactory adjustment of trade standards; second, to supply such assistance and advice as past experience with similar programs may suggest; third, to canvass and record the extent of acceptance and adherence to the standard on the part of producers, distributors, and users; and fourth, after acceptance, to publish and promulgate the standard for the information and guidance of buyers and sellers of the commodity.

4. *Announcement and promulgation.*—When the standard has been endorsed by a satisfactory majority of production or consumption in the absence of active, valid opposition, the success of the project is announced. If, however, in the opinion of the standing committee or the Department of Commerce, the support of any standard is inadequate, the right is reserved to withhold promulgation and publication.

ACCEPTORS

18. The organizations listed below have individually accepted this standard for use as far as practicable in the production, distribution, testing, or use of diamond powder. In accepting the standard they reserved the right to depart therefrom as they individually deem advisable. It is expected that articles that actually comply with the requirements of this standard in all respects will be regularly identified or labeled as conforming thereto, and that purchasers will require such specific evidence of conformity.

ASSOCIATIONS

(GENERAL SUPPORT)

Gemological Institute of America, Inc., Los Angeles, Calif.

FIRMS

Abrasive Dressing Tool Co., Detroit, Mich.
Action Diamond Tool Co., Chicago, Ill.
Adamant Tool Co., Bloomfield, N. J.
Aircraft & Diesel Equipment Corporation, Chicago, Ill.
Ajax Industrial Supplies, Inc., Ft. Wayne, Ind.
American Diamond Tool & Gauge Co., Detroit, Mich.
American Optical Co., Southbridge, Mass.
Bausch & Lomb Optical Co., Rochester, N. Y.
Bay State Abrasive Products Co., Diamond Wheel Division, Westboro, Mass.
Blits, H. & J., New York, N. Y.
Bowser Morner Testing Laboratories, Dayton, Ohio.
Brenon, Inc., New Brunswick, N. J.
Callite Tungsten Corporation, Union City, N. J.
Camden Wire Co., Inc., Camden, N. Y.
Carborundum Co., The, Niagara Falls, N. Y.
Cedar Rapids Engineering Co., Cedar Rapids, Iowa
Champion Diamond Co., New York, N. Y.
Cohn & Co., Sigmund, New York, N. Y.
Consolidated Diamond Saw Blade Corporation, Yonkers, N. Y. (General support).
Corundum Co., Inc., Cleveland, Ohio.
Crafts Co., Inc., Arthur A., Boston, Mass.
Crescent Insulated Wire & Cable Co., Trenton, N. J.
Detroit Testing Laboratory, The, Detroit, Mich. (General support).
Diamond Cutters Factory, New York, N. Y.
Diamond Detroit Tool Co., Detroit, Mich.
Diamond Development Co. of America, Inc., New York, N. Y.
Diamond Distributors, Inc., New York, N. Y.
Diamond Drill Carbon Co., The, New York, N. Y.
Diamond Productions, Inc., New York, N. Y.
Diamond Tool Research Co., New York, N. Y.
Diamond Wheel & Instrument Co., Inc., Yonkers, N. Y.
Driver Co., Wilbur B., Newark, N. J.
Duraffourg, Max, New York, N. Y.
Ekroth Laboratories, Inc., Brooklyn, N. Y.
Elgin National Watch Co., Elgin, Ill.
Felker Manufacturing Co., Torrance, Calif.
Flexo Wire Co., Syracuse, N. Y.
Fort Wayne Wire Die Co., Ft. Wayne, Ind.
Gatti, Inc., Aurele M., Trenton, N. J.
General Diamond Co., New York, N. Y.
General Electric Co., Schenectady, N. Y
Gilman Engineering Works, Janesville, Wis.
Golconda Diamond Products Corporation, Chicago, Ill.
Goodall Electric Manufacturing Co., Ogallala Nebr.
Hallmark Laboratories, The, Jamestown, N. Y.
Hamilton Watch Co., Lancaster, Pa.
Hoskins Manufacturing Co., Detroit, Mich.
Hudson Wire Co., Ossining, N. Y.
Husband Dental Supply Co., N. Hollywood, Calif.
Karelsen, Inc., E., New York, N. Y.
Kellogg Switchboard & Supply Co., Chicago, Ill.
Kitzel & Sons, E. C. Cleveland, Ohio.
Koebel Diamond Tool Co., Detroit, Mich.
Lam & Epstein, New York, N. Y.
Law & Co., Wilmington, N. C.
Lincoln Electric Co., Cleveland, Ohio.
Linde Air Products Co., The Tonawanda Laboratory, Tonawanda, N. Y.
Luginbill Wire Die Co., Ft. Wayne, Ind.
Meyers Co., W. F., Bedford, Ind.
Mildrum Jewel Co., The W. W., E. Berlin, Conn.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. (General support).
Moser Jewel Co., Perth Amboy, N. J.
National Standard Co., Niles, Mich.
National Tinsel Manufacturing Co., Manitowoc, Wis.
National Wire Die Co., New York, N. Y.
New England Carbide Tool Co., Inc., Diamond Division, Cambridge, Mass. (General support).
New England High Carbon Wire Co., Millbury, Mass.
Newark Wire Cloth Co., Newark, N. J.
Norton Co., Worcester, Mass.
P. & S. Diamond Tool Co., New York, N. Y.
Patzig Testing Laboratories, Des Moines, Iowa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Precision Diamond Tool Co., Chicago, Ill.
Prentiss & Co., Geo. W. Holyoke, Mass.
Radio Corporation of America, Camden, N. J.
Roebling's Sons Co., John A., Trenton, N. J.
Seneca Wire & Manufacturing Co., The, Fostoria, Ohio.
Service Diamond Tool Co., Ferndale, Mich.
Sinsz Co., The Philip, New York, N. Y.
Smit & Sons, Inc., J. K., New York, N. Y.
Spandel, Inc., H. R., New York, N. Y. (General support).
Standard Diamond Tool Corporation, New York, N. Y.
Strauss, Harry L., New York, N. Y.
Twin City Testing & Engineering Laboratory, St. Paul, Minn
Union Wire Rope Corporation, Kansas City, Mo.
United States Industrial Diamond Corporation, New York, N. Y.
United Wire & Supply Corporation, Cranston, R. I.
Universal Diamond Co., New York, N. Y.
Universal Wire Die Co., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Waltham Watch Co., Waltham, Mass.
Westinghouse Electric & Manufacturing Co., E. Pittsburgh, Pa.
Weston Electric Instrument Corporation, Newark, N. J.
Wheel Trueing Tool Co., Detroit, Mich.
Wickwire Spencer Metallurgical Corporation, Newark, N. J.
Wickwire Spencer Steel Co., Buffalo, N. Y.
Worcester Wire Works, Worcester, Mass.

U. S. GOVERNMENT

Agriculture, U. S. Department of, Washington, D. C.
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